EFFECT OF SOLIDIFICATION TIME TO THE WALL THICKNESS CREATED ON THE SLUSH CASTING PRODUCT

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SUPERVISOR'S AND CO-SUPERVISOR'S DECLARATION

We hereby declare that we have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

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STUDENT'S DECLARATION

I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. The project has not been accepted for any degree and is not concurently submitted for award of other degree.

Signature

Name:

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Date:

Dedicated to my beloved parents,

My siblings,

My supervisor and co-supervisor,

and all my friends

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In the name of Allah S.W.T the most gracious and merciful, first and foremost, after a year of struggle and hard work, with His will, this thesis is completed. Thanks to Allah for giving me the strength to complete this project and the strength to keep on living.

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ABSTRACT

Casting is most often used for making complex shapes that would be otherwise difficult or uneconomical to make by other methods is a manufacturing process by which a liquid material is usually poured into a mold, which contains a hollow cavity of the desired shape, and then allowed to solidify. After a certain time, the excess liquid will poured out, and then the solid casting is then ejected or broken out to complete the process.Casting may be used to form various materials that cold set after mixing of components (such as epoxies, concrete, plaster and clay Therefore, this study is conducted to fabricate the tool holder by using rubberwood as the material for the pattern, RTV-2 silicone rubber for the mould and polyester resin for product. The main objective of this study is to to study the effect of solidification time to the wall thickness created on the slush casting product to suit the function of product and find the optimum solidification time to achieve desire wall thickness for particular slush casting product. The study parameters are based on slush casting solidification time, which are 1, 2, 3, 4 and 5 minutes. The study output is wall thickness and digital vernier caliper is used to measure the dimension of wall thickness. Based on the measurement, only product have the value factor of safety (FOS) more than one, >1 is selected as a product. Based on the study analysis, it is discovered that the highest solidification time produce the highest wall thickness created on the product.

ABSTRAK

Proses tuangan bahan lebur ke dalam acuan atau “casting” seringkali digunakan untuk menghasilkan bentuk yang rumit memandangkan proses lain lebih sukar atau mahal dari perspektif ekonomi. Proses ini merupakan salah satu jenis proses pembuatan dimana bahan yang telah dileburkan akan dituang ke dalam acuan yang mengandungi rongga kosong mengikut bentuk yang dikehendaki, sebelum dibiarkan memejal. Selepas seketika, logam cair yang berlebihan akan dituang keluar meninggalkan bahan yang diacu. Bahan acu akhirnya diasingkan daripada acuan. Bahan acu boleh dihasilkan daripada set sejuk selepas campuran komponen seperti epoksi, konkrit, plaster dan tanah liat. Oleh itu, kajian ini dijalankan untuk menghasilkan paten penyimpan alat daripada kayu getah, acuan daripada getah silikon RTV-2 dan resin polisterin untuk produk. Matlamat utama ialah untuk mengkaji kesan masa pemejalan terhadap ketebalan dinding terbentuk pada bahan acu separa pejal untuk memenuhi fungsi produk dan menjamin masa pemejalan yang optimum. Kajian juga dilakukan untuk menentukan ketebalan dinding sesuai bagi produk acu separa pejal. Parameter kajian berdasarkan masa pemejalan bahan acu separa pejal ialah 1,2,3,4, dan 5 minit. Hasil kajian iaitu ketebalan dinding diukur menggunakan angkup vernier. Daripada ukuran, hanya produk yang mempunyai nilai faktor keselamatan (FK) lebih daripada satu, >1 dipilih sebagai produk. Berdasarkan kajian ini, masa pemejalan yang lama menghasilkan ketebalan paling tinggi terhadap produk.

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LIST OF SYMBOLS

°c	Celcious
%	Percent
cm	Centimetres
mm	Milimeter
min	Minute
kg	Kilogramme
inch	inches
N	Newton

LIST OF ABBREVIATIONS

RT	Rapid tooling
RP	Rapid prototyping
SL	Stereolithography
SLS	selective laser sintering
CAD	Computer-aided drafting
RTV	Room temperature vulcanizing
FOS	Factor of safety
Eq	Equation

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Slush casting is a manufacturing process by which a liquid material is poured into a mold, which contains a hollow cavity of the desired shape, and then allowed to solidify. The solid casting is then ejected or broken out to complete the process. Casting may be used to form hot liquid metals or various materials that cold set after mixing of components.

1.2 BACKGROUND OF STUDY

Tool holders are very useful product especially in engineering field. For this study a tool holder for holding screw driver will be fabricated. The main function of tool holder is to place the screw driver according to its size and function. Firstly, the design of the tool holder is designed by using SolidWorks software and then a pattern which is made from wood is produced. Next, the pattern will be used as mould for slush casting process to produce the final part. Finally, analysis is to find the optimum time for wall thickness created in the slush casting process.

1.3 OBJECTIVES OF STUDY

(i) To study the effect of solidification time to the wall thickness created on the slush casting product.

(ii) Find the optimum solidification time to achieve desire wall thickness for particular slush casting product.

1.4 SCOPE OF PROJECT

(i) Parameter concern for slush casting process is solidification time on the wall thickness.

(ii) The prototype will be designed using Solid Works software.

(iii) The pattern is made from wood and the final part is produced by using slush casting technique.

1.5 PROBLEM STATEMENT

In slush casting method, solidification time is the one important factor that will affect the wall thickness. The wall thickness of a product that is produced by slush casting technique depends on solidification time that can be control. To produce a product, wall thickness must be suit with its function for applied load.

In this study, wall thickness of the product must be achieve value of FOS more than one to make sure the product not easily crack.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter reviews relevant literatures on fabrication of pattern by hand works. Section 2.1 reviews on tool holder which states the important of tool holder.

2.2 TOOL HOLDER

Tool holder is a product that is used to hold tool equipment as shown in Figure 1. Actually, it is very important to avoid tool equipment from getting lost. The main function of tool holder is to place the equipment such as screw driver according to its size and function. This holder also helps mechanics especially in automotive and mechanical field to get the screw driver easily. For this study, tool holder will be designed with specific function which is to place the screw driver. This design will have three holes to place screw driver according to its size where the rod of the screw driver will be inserted into the hole. This holder is very compatible to be placed on the wall or at high place to avoid from children.

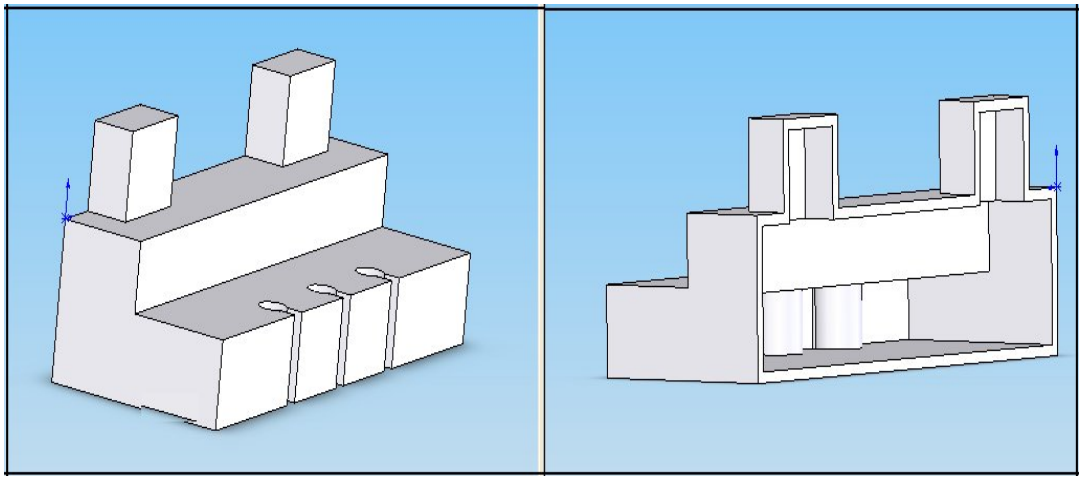

Figure 2.1: Tool holder

2.3 MANUFACTURING OF THE TOOL HOLDER

Normally, tool holder is made by plastic material. This holder is usually used in workshop, factory and other place where the place is not suitable for brittle material. That is why tool holder is made from plastic material because this will not easily crack and very light weight as compared to others material.

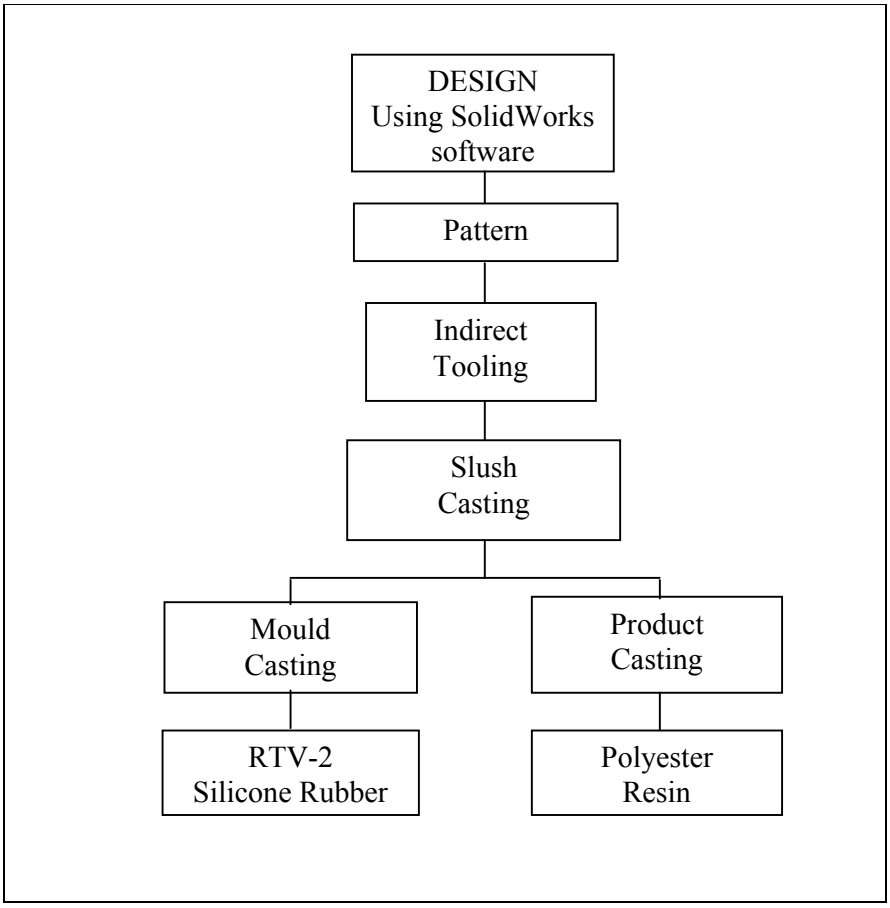

Figure 2.2: Development of Slush Casting in this Study

2.3.1 Development of Slush Casting

Figure 2.2 above shows the development of slush casting in this study. Firstly, the pattern will designed by SolidWorks software. Next, the pattern is made from wood as the material and mould will produce by using RTV-2 Silicone Rubber as the material. Finally, the final part is produced by using Polyester Resin as the material

2.4 EQUIPMENT TOOL FOR MEASUREMENT

In this study, measurement tool that will be used to measure the product is Digital Vernier Caliper, micro digital weighing machine and stop watch. Digital vernier caliper will be used to measure wall thickness while micro digital weighing machine will be used for weighing resin and silicone rubber. Stop watch will be used to record the solidification time. Details explanation of these tools will be discussed in the following section.

2.4.1 Digital Vernier Caliper

Thickness of the final product that is produced by slush casting process will be measured by digital vernier caliper Mitutoyo. These are the specification for this tool:

(i) Range: 0-6"(0-150mm).
(ii) Resolution: .0005"/0.01mm.
(iii) Accuracy: +/-0.0010".
(iv) ZERO/ABS Key: allows the display to be Zero-Set at any slider position along the scale for incremental comparison measurements.
(v) This switch will also allow return to absolute mode & display of the true position from the original point.
(vi) Maximum response speed: unlimited.
(vii) Alarm: low voltage, scale contamination, counting value composition error
(viii) Operating Temperature: 0ºC to 40ºC.
(ix) Can be hooked up to computer for data download (optional accessories required).

Figure 2.3: Digital Vernier Caliper Mitutoyo

Source: http://www.justtools.com

2.4.2 Micro Digital Weighing

In this study, micro digital weighing will be used to measure weight of material resin and silicone rubber.

Figure 2.4: Micro digital weighing

2.5 RAPID TOOLING

Rapid tooling is enabling art to production of quality parts and accelerating time to market by concentrating on the tool rather than the part (J. William, 1997). It is the ability to build prototype tools directly to prototype products from the CAD model resulting in compressed time to market solutions. The processes have been developed for generating durable injection moulds directly from computer data. These hard tooling solutions are based on sintered metal powder moulds usually infiltrated with copper. These hard tooling processes produce metal tools capable of surviving thousands of cycles. There are two types of rapid tooling processes, transfer and direct. Rapid prototyping and rapid tooling continue to have a huge impact in changing how products are designed and tested (D. King and T. Tansey, 2002). Rapid tooling (RT) processes have been developed to meet specific application and material requirements for moulding and casting. These may be forms of basic RP processes, such as stereolithography (SL) or selective laser sintering (SLS), or may be unique RP methods developed for a specific application. Typically a part made by the RP system is used as a pattern or model in these processes (J. C. Ferreira and A. Mateus, 2003).

In this study we will be indirect tooling method, is used which is silicone rubber casting technique to produce the final part of tool holder. The mould will be produced by pouring casting technique.

2.5.1 Indirect Tooling

Most rapid tooling today is indirect: RP parts are used as patterns for making molds and dies. RP models can be indirectly used in a number of manufacturing processes:

(i) Vacuum Casting: In the simplest and oldest rapid tooling technique, a RP positive pattern is suspended in a vat of liquid silicone or room temperature vulcanizing (RTV) rubber. When the rubber hardens, it is